## Bonneville Power Administration
## Fish and Wildlife Program FY99 Proposal Form

## Section 1. General administrative information

# Steelhead Supplementation Studies in Idaho Rivers

**Bonneville project number, if an ongoing project** 9005500

**Business name of agency, institution or organization requesting funding**

Idaho Department of Fish and Game

**Business acronym (if appropriate)** IDFG

**Proposal contact person or principal investigator:**


| | |
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**Subcontractors.** List one subcontractor per row; to add more rows, press Alt-Insert from within this table

| Organization | Mailing Address | City, ST Zip | Contact Name |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

**NPPC Program Measure Number(s) which this project addresses.**

3.3B.1, 4.1A, 4.1B, 4.2A, 4.3C, 5.0F.7, 7.1C.3, 7.1D.1, 7.1F.3, 7.1H.1, 7.3B.1, 7.3B.2, 7.4A.1, 10.5A

**NMFS Biological Opinion Number(s) which this project addresses.**

Biological Opinion. Reinitiation of Consultation on 1994 - 1998 Operation of the Federal Columbia River Power System and Juvenile Transportation Program in 1995 and Future

Years. Issued March 2, 1995.

**Other planning document references.**

If the project type is AWatershed≅ (see Section 2), reference any demonstrable support from affected agencies, tribes, local watershed groups, and public and/or private landowners, and cite available documentation.

Columbia Basin System Planning, Salmon and Steelhead Production Plan, Clearwater Subbasin, pages 117 - 186.

Columbia Basin System Planning, Salmon and Steelhead Production Plan, Salmon River Subbasin, pages 175 - 251.

Idaho Department of Fish and Game, Anadromous Fish Management Plan 1992 - 1996.

**Subbasin.**

Clearwater River subbasin and the Salmon River subbasin

**Short description.**

Evaluate the feasibility of using artificial production to increase natural steelhead populations and to collect life history, genetic, and disease data from wild steelhead populations in Idaho.

## Section 2. Key words

| Mark | Programmatic Categories | Mark | Activities | Mark | Project Types |
|---|---|---|---|---|---|
| x | Anadromous fish | | Construction | | Watershed |
| | Resident fish | | O & M | + | Biodiversity/genetics |
| | Wildlife | | Production | + | Population dynamics |
| | Oceans/estuaries | x | Research | | Ecosystems |
| | Climate | + | Monitoring/eval. | + | Flow/survival |
| | Other | | Resource mgmt | + | Fish disease |
| | | | Planning/admin. | x | Supplementation |
| | | | Enforcement | | Wildlife habitat en- |
| | | | Acquisitions | | hancement/restoration |

**Other keywords**.

Life history, genetics

## Section 3. Relationships to other Bonneville projects

| Project # | Project title/description | Nature of relationship |
|---|---|---|
| 89-09800 | Idaho supplementation studies (ISS) | We share equipment and personnel to snorkel streams, operate screw traps and PIT-tag juvenile steelhead. Steelhead data collected from study streams is used for age analysis, production and productivity estimates, and mainstem survival analysis. |
| 89-09801 | Salmon supplementation studies in Idaho rivers-USFWS | Data collected and used as above. |
| 89-09802 | Salmon supplementation studies in Idaho rivers-Nez Perce Tribe | Data collected and used as above. |
| 89-09803 | Salmon supplementation studies in Idaho rivers-Shoshone-Bannock Tribe | Data collected and used as above. |
| 91 - 073 | Idaho natural production monitoring and evaluation | Personnel from this project operate screw traps and PIT-tag juvenile steelhead at Rapid River, Red River, and Crooked River. Personnel at Rapid River assist the hatchery staff run the weir to enumerate and collect data from wild steelhead adults. We obtain summer parr density from their snorkel surveys in Rapid River and Red River. |
| 92-052 | Performance/Stock Productivity Impacts of Hatchery Supplementation | Share equipment and data. |
| | | |

## Section 4. Objectives, tasks and schedules

### *Objectives and tasks*

| Obj 1,2,3 | Objective | Task a,b,c | Task |
|---|---|---|---|
| 1 | Assess the performance of hatchery and wild brood sources to reestablish steelhead in streams where extirpated. Evaluate the brood sources in a hatchery and natural stream environment. | a | In stream: Outplant adults from each brood source into isolated and vacant habitat that is suitable for steelhead production using a paired watershed approach for three consecutive years. Study streams will be tributaries of the |

| | | | |
|---|---|---|---|
| | | | Salmon River upstream of the Sawtooth Hatchery. Enclose the section of stream where adults are stocked with picket weirs. Monitor spawning activity. |
| 1 | | b | In stream: Estimate parr production by snorkel surveys, trapping juvenile emigrants, and PIT-tagging. |
| 1 | | c | In stream: Estimate the smolt yield and number of emigrants from each brood year in streams by trapping and from PIT-tag detections at mainstem dams. |
| 1 | | d | In hatchery: Spawn and rear in the hatchery wild and hatchery brood sources for three consecutive years. Determine percent eye-up, survival, growth, health, and condition factor to the smolt stage of each brood source. Each brood source will be handled and reared equivalently, but in separate raceways. The in-hatchery studies will be done at Sawtooth Hatchery. |
| | | e | In hatchery: Release PIT-tagged smolts at weir sites to coincide with natural smolt migration. Using PIT tag detections, measure travel time and estimate survival to Lower Granite Dam of outplanted smolts from each brood source. |
| 1 | | f | In hatchery: Identify the brood source of adults returning to the weir. Compare smolt-to-adult survival, sex ratio, length, weight, age, fecundity, and timing of |

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|---|---|---|---|
| | | | return of adults of each brood source. |
| 1 | | g | Estimate recovery rates and the frequency of supplementation required to establish viable steelhead populations from results tasks a- f. Establish and maintain a library of supplementation research done elsewhere that will give insight into recovery and frequency rates of supplementation. Establish contacts and exchange information with other agencies involved with research that is pertinent to supplementation. |
| 2 | Evaluate the ability of returning adults from hatchery smolt and fingerling releases to produce progeny in natural streams. | a | Snorkel the South Fork Red River and Red River upstream of the South Fork Red River each summer to obtain baseline juvenile steelhead parr densities. |
| 2 | | b | Stock 50,000 marked (45,000 with CWT and 5,00 PIT-tagged) fingerlings reared at Clearwater Hatchery into the South Fork Red River in early September for four consecutive years (done 1993 - 1996). |
| 2 | | c | Stock 5,000 PIT-tagged smolts reared at Clearwater Hatchery into Red River in April, upstream of the South Fork Red River, for four consecutive years (1996 -1999). The lag between stocking smolts and fingerlings was planned so most of the smolts from each group migrate to the ocean the same year(s). |
| 2 | | d | Operate the Red River weir to catch returning adult steelhead from 1997 - 2002. Determine the origin of adults and sex, measure length, and pass upstream. |
| 2 | | e | Using the snorkel information compare parr production per |

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|---|---|---|---|
| | | | female of each group. |
| 2 | | f | Estimate recovery rates and the frequency of supplementation required to establish viable steelhead populations from results tasks 1- 5. |
| 3 | Assess the abundance, habitat, and life history characteristics of existing wild steelhead populations in the Salmon and Clearwater river drainages. | a | Use existing weirs and traps to document the timing, number, length, and age (from scale sampling) of wild juvenile steelhead in selected streams. We are PIT-tagging all steelhead juveniles > 75 mm at all ISS screw trap locations, Fish Creek, and Rapid River. |
| 3 | | b | Estimate wild adult steelhead escapement into streams with weirs. Record length of adults, sex ratio, age, and date of return. We are collecting this data from hatchery weir sites on Clear Creek, Rapid River, Pahsimeroi River, and the Salmon River at Sawtooth Hatchery. We install a temporary weir each spring in Fish Creek. |
| 3 | | c | Obtain baseline genetic (non-lethal sampling of tissue/fins for DNA analysis) and pathogenic data on steelhead populations from representative streams throughout the state. |
| 3 | | d | Record temperature throughout the year in selected streams in the Salmon and Clearwater drainages. Presently, we are recording temperatures in 40 streams. |
| 3 | | e | Snorkel streams that can serve as indicators of steelhead population within the major drainages. Fish Creek and Gedney Creek are being used as indicator streams for the Lochsa and Selway drainages, |

| | | | |
|---|---|---|---|
| | | | respectively. |
| 3 | | f | Using the PIT-tagged fish from traps identified in task a estimate steelhead out-migration from each stream using mark-recapture methodologies, determine growth rate from recaptured fish, develop smolt migration timing through the mainstem Snake River using dam detections, and where sample size is large enough estimate smolt-to-adult survival. |
| 4 | Evaluate broodstock management at existing hatchery weirs in relation to IDFG natural production objectives. | a | Review existing policy for passing adults and stocking hatchery fry, fingerlings, and smolts upstream of hatchery weirs. Monitor adult escapement, juvenile densities, and smolt production, upstream of the weir sites. |

### *Objective schedules and costs*

| Objective # | Start Date mm/yyyy | End Date mm/yyyy | Cost % |
|---|---|---|---|
| 1 | 01/1993 | 12/2008 | 15% |
| 2 | 01/1993 | 12/2003 | 10% |
| 3 | 01/1993 | 12/2024 | 70% |
| 4 | 01/1993 | 12/2024 | 5% |

**Schedule constraints.**

**All objectives:** Because steelhead are now listed under ESA, we must obtain permits to continue the work we began 1993, however IDFG does not anticipate any restrictions of the tasks associated with this research.

**Objective 1:** We have not had enough wild fish returning to Idaho to remove them from their natural spawning areas to use in experiments outlined. We have stocked hatchery adults that returned to Sawtooth Hatchery in Beaver and Frenchman creeks yearly since 1993. We are viewing this as a case study to determine if the Sawtooth Hatchery stock can be used to reestablish a self-sustaining population in the upper Salmon River drainage. We are monitoring parr production with yearly intensive summer snorkel surveys to estimate densities and abundance.

**Objective 2:** This objective has progressed as planned. We stocked 50,000 Dworshak

stock fingerlings reared at Clearwater Hatchery each fall from 1993 to 1996 in the South Fork Red River. We stocked Dworshak stock smolts reared at Clearwater Hatchery in the spring of 1996 and 1997 in Red River. We will make two more smolt stockings this spring and in 1999. IDFG personnel will operate the Red River hatchery weir to trap steelhead adults yearly until 2003. We have intensively snorkeled Red River and the South Fork Red River yearly since 1993. The first returning adults are expected during the spring 1998.

**Objective 3:**. This objective has progressed as planned. We are monitoring population status, gathering life history information, and genetic data from wild steelhead populations. A brief summary of our work on this objective, by year, follows.

**1993**

1) Intensively snorkeled 8 streams to obtain juvenile steelhead densities.
2) Recorded stream temperatures at 17 sites in 17 streams.
3) Collected 4,748 and PIT-tagged 2,870 juvenile steelhead in 6 streams. Obtained the length, weight, condition factor, and migration timing of juvenile steelhead from the streams.
4) Collected scales from juveniles in 1 stream and adults from 4 streams.
5) Did a stream habitat survey in 5 streams.
6) 318 PIT-tagged fish were detected at the Snake River and McNary dams.

**1994**

1) Intensively snorkeled 11 streams to obtain juvenile steelhead densities.
2) Recorded stream temperatures at 34 sites in 29 streams.
3) Collected 9,312 and PIT-tagged 6,314 juvenile steelhead in 12 streams. Obtained the length, weight, condition factor, and migration timing of juvenile steelhead from the streams.
4) Collected scales from juveniles in 5 streams and adults from 3 streams
5) Did a stream habitat survey in 4 streams.
6) 795 PIT-tagged fish were detected at the Snake River dams and McNary Dam.

**1995**

1) Intensively snorkeled 8 streams to obtain juvenile steelhead densities.
2) Recorded stream temperatures at 36 sites in 32 streams. Recorded air temperature, relative humidity, and air pressure at Fish Creek.
3) Installed a temporary weir in Fish Creek to collect wild adult steelhead escapement, length, sex ratio, and scales.
4) PIT-tagged 3,4314 juvenile steelhead in 7 streams. Obtained the length, weight, condition factor, and migration timing of juvenile steelhead from the streams.
5) Collected scales from juveniles in 4 streams and adults from 5 streams
6) Did a stream habitat survey in 1 stream.
7) 1,305 PIT-tagged fish were detected at the Snake River dams and McNary Dam.

**1996**

1) Intensively snorkeled 12 streams to obtain juvenile steelhead densities.
2) Recorded stream temperatures at 38 sites in 34 streams. Recorded air temperature, relative humidity, and air pressure at Fish Creek.
3) Installed a temporary weir in Fish Creek to collect wild adult steelhead escapement, length, sex ratio, and scales.
4) Collected 8,321 juvenile steelhead PIT-tagged 7,998 in 11 streams. Obtained the length, weight, condition factor, and migration timing of juvenile steelhead from the streams.
5) Collected scales from juveniles in 2 streams and adults from 1 stream.
6) Did a stream habitat survey in 5 streams.
7) 1,317 PIT-tagged fish were detected at the Snake River dams and McNary Dam.

**1997**

1) Intensively snorkeled 13 streams to obtain juvenile steelhead densities.
2) Recorded stream temperatures at 41 sites in 36 streams. Recorded air temperature, relative humidity, and air pressure at Fish Creek.
3) Installed a temporary weir in Fish Creek to collect wild adult steelhead escapement, length, sex ratio, and scales.
4) Began operating the screw trap in Rapid River and assisted hatchery personnel operate the weir during the steelhead run.
4) Collected 7,000 juvenile steelhead and PIT-tagged 6,000 (preliminary numbers) in 11 streams. Obtained the length, weight, condition factor, and migration timing of juvenile steelhead from the streams.
5) Collected scales from juveniles in 4 streams and adults from 2 streams.
6) Did a stream habitat survey in 1 stream.
7) Collected fin samples for future DNA analysis from adults in Fish Creek and Rapid River. Collected fin samples for future DNA analysis from juvenile steelhead in Fish Creek, Rapid River, and two tributaries of the Little Salmon River
8) We mounted and aged all of the scales we collected from 1993 - 1997. A total of 432 and 2,766 adult and juvenile scales, respectively, were aged.
9) 3,024 PIT-tagged fish were detected at the Snake River dams and McNary Dam.

**Completion date.**

This project is designed to help achieve recovery of ESA listed steelhead trout and is expected to continue until recovery is attained. Recovery of steelhead should mimic that of chinook salmon and is not expected until 2024 (U. S. Department of Commerce, NOAA, 8/97 Draft of the Snake River Salmon Recovery Plan).

## Section 5. Budget

### *FY99 budget by line item*

| Item | Note | FY99 |
|---|---|---|
| Personnel | includes permanent and seasonal staff | 100,000 |
| Fringe benefits | includes all employee benefits | 35,000 |
| Supplies, materials, non-expendable property | | 8,000 |
| Operations & maintenance | | 20,000 |
| Capital acquisitions or improvements (e.g. land, buildings, major equip.) | Primarily for upgrades of computers and PIT-tag equipment for 135 tags. | 15,000 |
| PIT tags | # of tags: 8,000 | 23,200 |
| Travel | includes travel for permanent staff and all subsistence needs for the project=s field work | 10,000 |
| Indirect costs | | |
| Subcontracts | DNA analysis | 10,000 |
| Other | Agency overhead (21.3% of personnel and operating) | 37,000 |
| **TOTAL** | | 258,200 |

### *Outyear costs*

| Outyear costs | FY2000 | FY01 | FY02 | FY03 |
|---|---|---|---|---|
| Total budget | 258,000 | 268,000 | 278,000 | 288,000 |
| O&M as % of total | 10% | 10% | 10% | 10% |

## Section 6. Abstract

The goal of supplementation is to use artificial propagation to increase natural fish production without a negative effect on the productivity and abundance of existing natural populations. The Northwest Power Planning Council identified supplementation to generate much of the increases to meet its goal of doubling anadromous fish runs in the Columbia River. The goal of supplementation: an increase in natural production, is a departure from previous hatchery management. Guidelines and procedures for supplementation are not established. This project was designed to investigate potential benefits and risks with small-scale experiments and to develop protocols for biologically sound steelhead supplementation. We used the Regional Assessment of Supplementation Project (RASP) guidelines to formulate the research design.

The major objectives of this research are:

1. Assess the performance of hatchery and wild brood sources to reestablish steelhead in streams where extirpated.

2. Evaluate the ability of returning adults from hatchery smolt and fingerling releases

to produce progeny in natural streams.

3. Collect baseline population status, life history attributes, and genetic data from wild steelhead populations in key indicator tributaries of the Salmon and Clearwater drainages.

We minimized the risk to natural populations of steelhead and chinook salmon by choosing study streams, for Objectives 1 and 2, that are vacant of steelhead or are no longer managed as viable populations. Our manipulative experiments are small-scale, includes stocking for three or four brood years, and are not intended to produce viable populations of steelhead.

## Section 7. Project description

### a. Technical and/or scientific background.

The Northwest Power Planning Council has identified supplementation as a high priority to achieve its interim goal of doubling anadromous fish runs in the Columbia River basin (NPPC 1987). In the System Planning process, over 70% of the total planned increases in steelhead Oncorhynchus mykiss production in the Columbia River basin were attributed to supplementation (D. Anderson, NPPC, personnel communication in RASP 1992). In the Snake River basin 95% of the A-run and 72% of the B-run planned steelhead production increases were expected from supplementation. All naturally produced steelhead in Idaho were listed as a threatened species under the Endangered Species Act in 1997.

Hatchery production and supplementation have existed in the Columbia Basin for over 100 years but rigorous scientific evaluation of supplementation on natural production is sparse and results discouraging (Smith et al. 1985; Miller et al. 1990; Stewart and Bjornn 1990; Hindar et al. 1991). The few studies that evaluated the effect of supplementation on naturally produced salmonids found that hatchery fish did not perform as well as natural fish (Chilcote et al. 1986; Nickelson et al. 1986; Leider et al. 1990). An assessment of supplementation objectives, benefits, and risks should occur prior to implementation. Idaho Department of Fish and Game (IDFG) proposes this research to assess supplementation risks.

The major supplementation question that needs to be resolved is whether it is possible to integrate artificial and natural production without an unacceptable risk to natural populations. Potential supplementation risks include: reducing natural productivity below sustainable levels through genetic introgression with a less fit supplementation stock, displacement of naturally produced fish through behavioral interactions with supplementation fish, transmission of diseases, excessive straying of returning hatchery adults, taking too many wild adults into the hatchery for supplementation, and inadvertent selection or domestication of donor stocks brought into the hatchery. These risks should be addressed prior to the implementation of large scale stocking programs.

The goal of supplementation is to increase natural fish production using artificial propagation without a negative impact on the productivity or abundance of existing natural fish populations. Providing a sustainable benefit from supplementation without an improvement in passage conditions is highly unlikely (Byrne, et al. 1992). For supplementation to be beneficial, we believe our hatcheries must propagate a fish that is compatible with existing natural stocks. This approach represents a departure from conventional hatchery practice in that success is measured by the ability of returning adults to produce viable offspring in the natural stream environment. Guidelines and procedures to accomplish this new hatchery goal are not established. Research is required to resolve the risks and uncertainties associated with integrating artificial and natural production.

We propose a series of short-term studies that address specific hypotheses about supplementation methods and to gather baseline population status, life-history, and genetic data from wild populations. Although a supplementation program will not be implemented, the Regional Assessment of Supplementation Project (RASP) guidelines for supplementation programs were used to formulate the research design. We focus on baseline data collection from wild steelhead populations within Idaho (RASP steps 2 and 3), an analysis of limiting factors (RASP step 4), methods to increase steelhead abundance (RASP step 6), and the assessment of risks and benefits of supplementation methods (RASP step 7). The results of this research will be used to guide steelhead supplementation decisions in Idaho. This research provides information to help achieve the goals of the Columbia River Basin Fish and Wildlife Plan (FWP) outlined in Section 4 (establishing principles to met the Salmon and Steelhead doubling goal), Section 5 (by PIT-tagging wild steelhead stocks for flow, travel time, and survival studies), and Section 7 (by collecting life-history, genetic, and abundance data on wild populations in Idaho).

**b. Proposal objectives**.

**1) Objective 1: Assess the performance of hatchery and wild brood sources to reestablish steelhead in streams where extirpated**.

Hypothesis: There is no difference among different brood sources to establish natural production.

Ideally, supplementation utilizing various brood sources would be assessed at the population level by releasing different broods of fish into separate drainages and tracking fish abundance, survival, and life history attributes (sex ratio, fecundity, size, etc.) over several generations for each population. Because of the large number of streams and fish that would be required, risks associated with supplementation uncertainties, and the desire to expedite feedback, we have partitioned this research hypothesis into four chronological components (RASP 1992) which will be tested somewhat independently:

in-hatchery survival, post-release survival, reproductive success, and long-term fitness.

In-hatchery (egg-to-smolt) and post release (smolt-to-Lower Granite Dam and smolt-to-adult) survival will be measured directly, providing information within 2-4 years. Adult returns from these releases will probably be inadequate to establish populations and measure reproductive success or long-term fitness. Even if the adult returns are adequate, inferences concerning reproductive success and long-term fitness could not be made until 5-8 years after the research was initiated. Because of these factors, reproductive success and long-term fitness will be assessed indirectly with separate groups of fish. These experiments will be implemented concurrently with the in-hatchery and post release survival experiments. The surrogate for reproductive success will be juvenile age 1 production from adult outplants of each brood source into vacant habitat. If enough adults can be outplanted, successfully spawn, and smolt production monitored, smolt yield can be used as a surrogate for long-term fitness. Experiments designed for this objective will be done in the Salmon River tributaries upstream of Sawtooth Hatchery.

Products: The egg-to-smolt survival, growth rate, and post-release smolt-to-adult survival of hatchery reared wild and hatchery brood sources of fish will be calculated. The number of parr and smolts produced per female from wild and hatchery brood sources outplanted in streams will be estimated.

**2) Objective 2: Evaluate the ability of returning adults from hatchery smolt and fingerling releases to produce progeny in natural streams**.

Hypothesis: There is no difference between fingerling or smolt stockings in establishing natural steelhead production as measured by $F_1$ age 1 juvenile abundance.

Our research will focus on life stage of release using an established hatchery stock. We will compare the abundance of age 1 steelhead parr produced by naturally spawning adults that were released as hatchery fingerlings or smolts. Because of limited research opportunities we will use only an established hatchery brood stock(s) to test this hypothesis. Fingerlings (rather than fry) were chosen since the fish can be fin marked and PIT tagged prior to release into the study streams. The primary evaluation point will be age 1 parr abundance but tasks are included to monitor the subsequent smolt production. This objective will be investigated in the Red River drainage, a tributary of the South Fork Clearwater using Dworshak hatchery stock reared at Clearwater Hatchery.

Products: Estimates of the survival from stocking to returning adult and the reproductive success of the adults can help managers chose the appropriate life stage to release fish for supplementation.

### 3) Objective 3: Assess the abundance, habitat, and life history characteristics of wild steelhead populations in the Salmon and Clearwater river drainages.

Data collected for this objective will address the following questions identifies by RASP: (1) what were the historical stream and stock characteristics, (2) what is the current status, trend, and performance attributes of steelhead stocks within Idaho, (3) are habitat and survival adequate for supplementation to be successful, and (4) how do we best match donor to recipient stocks and habitat requirements for supplementation.

We are intensively monitoring wild/natural steelhead populations in Fish Creek (Lochsa River tributary), Rapid River (Salmon River tributary), Clear Creek (Middle Fork Clearwater River), Pahsimeroi River and the Salmon River upstream of Sawtooth Hatchery by enumerating adult escapement with weirs, yearly snorkel surveys for juvenile densities, and trapping out-migrants with screw traps and PIT-tagging them to estimate smolt yield, travel time, life-history attributes, and migration patterns to Lower Granite Dam. In Gedney Creek (Selway River tributary) we intensively monitor the population status with yearly snorkel surveys and PIT-tag 600 - 1,200 juveniles collected during the summer. We intensively snorkel 4-6 additional Lochsa River tributaries yearly to monitor population status. We are recording temperatures in streams throughout the state. We will conduct a genetic analysis of our wild/natural stocks, using non-lethal tissue sampling for DNA analysis.

Products: We will measure wild adult escapement, sex ratio, and determine age structure from indicator streams. We will maintain a database of juvenile parr densities in indicator steelhead streams. At the screw trap sites we will estimate the number of migrants, determine length frequency, condition factor, migration pattern, age of fish from scale analysis, growth rate from scales and PIT-tagged fish that are recaptured. The survival, arrival timing, and migration through the mainstem Snake River of wild steelhead smolts can be monitored with the fish we PIT-tag. We can estimate wild smolt-to-adult survival using the PIT-tagged fish. We will do a genetic analysis of wild steelhead stocks. Stream temperatures are being recorded year-round from steelhead production streams through the state. Data collected from this objective may be used to match donor and recipient stocks for supplementation purposes.

### 4) Objective 4: Evaluate brood stock management at existing hatchery weirs in relation to natural production goals.

We will review existing policy for adults, stocking hatchery fry, fingerlings, and smolts upstream of the weir and in other streams . At each weir site, where there are natural production goals upstream, gather adult return, sex ratio, age structure, and timing of returning hatchery and natural adults. If changes are implemented they will be evaluated to assess the effects on natural and hatchery production. Most of this information for this objective is available from hatchery reports and other monitoring projects.

Products: This project will centralize data from Kooskia Hatchery (Clear Creek), Sawtooth Hatchery (Salmon River), Pahsimeroi Hatchery, Rapid River Hatchery, East Fork Salmon River Satellite Facility, Crooked River Satellite Facility, and the Red River Satellite Facility and coordinate collection and monitoring tasks with hatchery and regional IDFG personnel.

**c. Rationale and significance to Regional Programs**.

The Steelhead Supplementation Study investigates: (1) strategies and develops protocols that may be used in a supplementation program to increase the abundance of naturally produced steelhead and (2) monitors populations and life-history characteristics of wild steelhead populations. This project cooperates and shares data with the Nez Perce Tribe, Shoshone-Bannock Tribe, U.S. Fish & Wildlife Service, Lower Snake River Compensation Plan, and the U.S. Forest Service.

**Objective 1:** This objective investigates supplementation methods and helps achieve the FWP goals in Section 4.2A of reducing scientific uncertainty and increasing knowledge to increase fish runs and Section 4.3 to develop rebuilding targets and plans. Information gathered by this project can be used by IDFG fish managers in an adaptative management framework (FWP, Section 3.2).

**Objective 2**: This objective investigates supplementation methods and helps achieve the FWP goals in Section 4.2A of reducing scientific uncertainty and increasing knowledge to increase fish runs and Section 4.3 to develop rebuilding targets and plans. Information gathered by this project can be used by IDFG fish managers in an adaptative management framework (FWP, Section 3.2).

**Objective 3:** The data collected from this objective helps met the goals of the FWP Section 7 as follows: (1) 7.0-population status of adults and juveniles can be used to update and keep current Subbasin Plans, (2) 7.1B-the genetic analysis of wild populations enables us to identify and conserve genetic diversity, (3) 7.1C and 7.1D-data collected allows us to maintain long term databases and to develop a profile on the population status, genetic, life-history, and morphological characteristics and to protect and manage wild populations. (4) This project monitors bull trout population status and gathers life-history information at Rapid River. This meets goals of the FWP Section 10.5A.

**Objective 4:** This objective furthers the FWP goals of Sections 7.1F, 7.1G, and 7.1H by better managing hatchery stocks to minimize negative impacts on existing wild/natural populations.

**d. Project history**

The Steelhead supplementation study experimental design was written in 1992 and submitted to BPA in December, 1992. The field work began in 1993. This project has outplanted hatchery adult steelhead and estimate parr production yearly in Beaver and Frenchman creeks from 1993 - 1997. We stocked hatchery fingerlings each fall from 1993 - 1996 and estimated summer parr abundance from 1993 - 1997 in the South Fork Red River. We stocked hatchery smolts in Red River and estimated survival and travel time to Lower Granite Dam in 1996 and 1997. This project has developed several databases for wild steelhead in Idaho. We have done yearly snorkel surveys of key indicator steelhead streams, stream habitat surveys, and assembled the information into a database. We have monitored wild adult escapement, sex ratios, and age at hatchery weirs sites and Fish Creek. Juvenile steelhead age, length, condition factor, growth rates, migration patterns, and number of migrants has been documented yearly at 6-12 streams with screw traps. We PIT-tagged over 26,500 wild steelhead parr and smolts since 1993 and created databases with number tagged, length, weight, and other relevant information. We have detected over 5,400 wild steelhead smolts at the mainstem dams and have developed a database with tag site, release date, release length and weight, detection site and date, and travel time into a database. We have a wild steelhead age/length database, based on scale analysis, for adults (n = 432) and juveniles (n = 2,766) collected from indicator streams in the Salmon and Clearwater drainages. We began a long-term stream temperature database in 1993 and are monitoring temperatures in 40 indicator streams in the Salmon and Clearwater drainages. In addition to gathering and providing information on wild steelhead status, this project has provided managers with bull trout escapement, out-migrant numbers and timing, and has PIT-tagged juvenile bull trout at Rapid River.

Project reports include:

Byrne, Alan. 1994. Steelhead supplementation studies in Idaho rivers. Experimental Design. Idaho Department of Fish and Game, Boise. 90 pp.

Byrne, Alan. 1995. Steelhead supplementation studies in Idaho rivers. 1993 Annual Report to the U.S. Department of Energy, Bonneville Power Administration. Contract No. DE-B179-89BP01466, Project 90-055. Idaho Department of Fish and Game, Boise. 60 pp.

Byrne, Alan. 1997. Steelhead supplementation studies in Idaho rivers. 1994 Annual Report to the U.S. Department of Energy, Bonneville Power Administration. Contract No. DE-B179-89BP01466, Project 90-055. Idaho Department of Fish and Game, Boise. 90 pp.

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**e. Methods**.

A detailed experimental design that includes, objectives, methods, study area, tasks, assumptions, and statistical and power analysis was submitted to BPA in December, 1992. The reference is:

> Byrne, Alan. 1994. Steelhead supplementation studies in Idaho rivers. Experimental Design. Idaho Department of Fish and Game, Boise. 90 pp.

**Statistical DesignStatistical Design**

Experiments can be analyzed with a completely randomized factorial design or t-tests to test for in-hatchery growth, condition factor, and health differences among brood stocks. Since most of the experiments in this study will be repeated on a yearly basis for three to four years, the data will be analyzed upon completion of the experiments with ANOVA using a repeated measures design (split plot in time).

Analysis of the adult return from one smolt release can be done using the standard chi-square test for independence. Log-linear models will be used to analyze several years of smolt releases and adult returns. Log linear models are a good method for analysis of survival data of known numbers of smolt releases since we are dealing with ordinal (count) data. Green and MacDonald (1987) used log-linear models to analyze several years of hatchery return data.

Several nonparametric statistics will be used for data analysis. Kolomogorov-Smirnov statistics will be used to test for differences in distribution functions of spawning time, time of emigration, and time of smolt migration. A Cox-Stuart test for trend will be used to test for changes in adult escapement and juvenile densities if changes are made at existing weir sites and the binomial test can be used to test for changes in sex ratios.

The comparison of wild and hatchery brood source in streams (Objective 1) and parr production from fingerlings and smolts (Objective 2) are being viewed as case studies using a paired watershed design. We do not have enough fish or streams to assess the experiments otherwise. I did a power analysis using a split plot in time design, power of 80%, CV of 20%, and % = 0.1 and determined that we would need 6 streams per brood source or life stage to detect a 50% difference in parr and smolt abundance.

**Tasks**

**Objective 1**
A) In-hatchery component

4. Collect wild adults and transport to Sawtooth Hatchery.
5. Spawn and rear wild and hatchery fish equivalently but in separate raceways.
6. Develop a length and fecundity relation for each brood source.
7. Measure length and weight monthly, and survival to smolt.
8. Transport 500 smolts from each brood source to Marrowstone Field Station (USGS, National Biological Service) and do a 3 month sea water growth and survival test.
9. Differentially mark the brood sources, release at the same time, and determine survival from egg-to-smolt and smolt-to-adult.

7 Repeat for three or four consecutive years.

B) Stream component

10. Outplant equal numbers of wild and Sawtooth Hatchery adults into two separate streams upstream of Sawtooth Hatchery.
11. Monitor spawning and estimate egg deposition in each stream.
12. Snorkel streams to estimate juvenile parr abundance yearly.
13. Estimate out-migration with traps, PIT-tag migrants, and estimate smolt yield.
14. Repeat for three or four consecutive years.

**Objective 2**

15. Stock the South Fork Red River with 50,000 fingerlings (5,000 PIT-tagged and 45,000 CWT) in September for four consecutive years (done 1993 - 1996).
16. Snorkel South Fork Red River and Red River upstream of the South Fork each summer to obtain steelhead parr densities.
17. Stock Red River upstream of the South Fork with 4,000 PIT-tagged smolts for four consecutive years beginning in April 1996. The time lag was planned so most of the smolts produced from the fingerling stockings migrate to the ocean the same year(s) of the smolt releases.
18. Operate the Red River hatchery weir to determine the adult return from each group f rom 1997 - 2003.
19. Compare parr production from adults that return to spawn in Red River and South Fork Red River.

**Objective 3**

1 Monitor wild/natural adult escapement, length frequency, sex ratios, and arrival timing at hatchery weirs and Fish Creek each year.

2 Monitor wild steelhead parr densities in indicator streams of the Clearwater and Salmon drainages with yearly snorkel surveys during the summer.

3 Operate screw traps in Fish Creek and Rapid River. Estimate out-migration with mark-recapture methodology, measure length, weight, and collect scales from migrants. PIT-tag all steelhead > 70 mm. Coordinate with other IDFG projects and other agencies to PIT-tag steelhead at screw traps operated for the chinook supplementation study.

20. Collect fin samples for DNA analysis of steelhead stock structure from streams throughout the Clearwater and Salmon drainages.
21. Record the stream temperature on a yearly basis from streams throughout the Clearwater and Salmon drainages.

**Objective 4**

22. Obtain wild adult steelhead escapement, lengths, and sex ratios from hatchery weir sites and maintain a wild escapement database.
23. Assist hatchery and regional IDFG personnel monitor steelhead abundance upstream of weirs and evaluate any changes that are made in brood stock management at hatchery weirs.

**f. Facilities and equipment**.

This project can rely on the personnel, equipment, and infrastructure of IDFG for assistance. Housing for personnel during field work are in place using existing IDFG structures, trailers, or camping equipment. All equipment needed for fieldwork such as, vehicles, screw traps, PIT-tagging gear, snorkeling gear, nets, waders, etc have been already been purchased. Items that need to be replaced due to wear or use (wet suits, waders, etc) are include in the yearly Operations & Maintenance budget. Within the next few years we will need to upgrade the PIT-tagging equipment because of the switch to a new tag frequency. IDFG has enough existing office space to house personnel of this project. Office computers may need to be upgraded as needed to utilize new technologies.

**g. References.**


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## Section 8. Relationships to other projects

This project was integrated into many existing IDFG projects and relies on regional and hatchery personnel to assist with the tasks outlined in the study design. Examples include cooperation with snorkel surveys, redd counts, and operating screw traps. Hatchery fish for this study are provided by the Clearwater and Sawtooth hatcheries. Sawtooth Hatchery personnel and Salmon Regional personnel assist us in outplanting adults in tributaries of the Salmon River upstream of Sawtooth Hatchery. Personnel from Rapid River help operate the screw trap located there. Personnel from this project have assisted Rapid River Hatchery personnel handle, sort, and spawn chinook salmon This project provides data on resident fish, steelhead and chinook salmon to IDFG managers in the Lewiston, McCall, and Salmon regions and the Headquarters Fisheries Bureau. This project provides data used in the PATH process and the Steelhead Managers Symposium which is a group of managers from all West Coast states and British Columbia that meets every two years.

Other cooperative efforts include:

24. Idaho Department of Transportation at Lowell plows snow off roads in the early spring so we can install the adult weir and screw trap in Fish Creek.
25. U.S. Fish & Wildlife Service hatchery at Kooskia provides storage area for the Fish Creek weir and other equipment used at Fish Creek.
26. The Nez Perce Tribe, Shoshone-Bannock Tribe, and U.S. Fish and Wildlife Service provide snorkel data and PIT-tag steelhead at screw traps they operate.

## Section 9. Key personnel

The principle investigator of this IDFG project is Alan Byrne, Senior Fisheries Research Biologist. Alan obtained a BA in biology from Potsdam State College (1974) and a MS in Fisheries from the University of Idaho (1988). He was employed by the U.S. Fish and Wildlife Service, National Fisheries Research Center, Seattle, WA as a Fisheries Research Biologist from 1988 - 1991 before accepting his present position with Idaho Fish and Game in January 1992.

List of Publications:

Byrne, A., T.C. Bjornn, and J.D. McIntyre. 1992. Modeling the response of native steelhead to hatchery supplementation programs in an Idaho river. North American Journal of Fisheries Management 12:62-78.

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## Section 10. Information/technology transfer

Information from this project is made available to IDFG fisheries managers by memos and reports that summerize pertinent information several times each year. An annual progress report is prepared yearly and a five year summary report of this research will be written in 1998. Data from this study is used by scientists involved in the PATH process. The fish abundance data is incorporated into the STREAMNET database and all PIT-tag

data is entered into the PITAGIS database maintained by the Pacific States Marine Fisheries Commission. This research will submit several articles to professional fisheries journals in the future on supplementation strategies, steelhead life history and survival, growth, and migration patterns gained from our PIT-tag studies.